UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/910,914	07/24/2001	Kie Y. Ahn	M4065.0461/P461	2806

24998 7590 10/28/2003

DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP
2101 L STREET NW
WASHINGTON, DC 20037-1526

EXAMINER	
FOONG, SUK SAN	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 10/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/910,914	AHN ET AL.	
	Examiner	Art Unit	
	Suk-San Foong	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 June 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9,11-14,16-19 and 21-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,11-14,16-19 and 21-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *7/29/03* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1-6, 9, 11-13 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. ('880) in combination with Lopatin et al. ('954), Applicant's Admitted Prior Art (AAPA) and Kaloyeros et al.

Jiang et al. is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03.

Jiang et al. do not list methylsilsesquiazane as one of the low-k dielectric materials and do not teach patterning low dielectric constant layer to form openings.

AAPA is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the step of forming openings

through the low dielectric constant layer in order to eliminate both photoresist and dry etching process steps.

The combination process does not disclose that the barrier layer is formed using tungsten nitride (WN).

In regard to claim 24, the combination process does not teach depositing copper layer by chemical vapor deposition.

Lopatin et al. is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of barrier layer 106 comprise of tungsten nitride material in trench 120 of the combination process to be performed and to provide excellent adhesion to the underlying low dielectric material (Lopatin et al., Col. 5, lines 37-39)

Lopatin et al. is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of copper layer 110 over trench 120 and IMD 104 of the combination process to be performed

In regard to claims 11-13, and 25-27, the combination process not disclose the steps as recited in claims 11-13, and 25-27 during copper deposition.

AAPA is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the step of depositing copper layer 110 of the combination process to be performed.

The combination process does not teach that copper is selectively deposited using a low-temperature metal-organic chemical vapor deposition method.

Kaloyeros et al. is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of copper layer 110 of the combination process to be performed and obtain further advantage of copper film having uniform, continuous and low resistivity (Kaloyeros et al., p. 84, 1st paragraph).

4. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. ('880) in combination with Lopatin et al. ('954), Applicant's Admitted Prior Art (AAPA) and Kaloyeros et al. as applied to claims 1-6, 9, 11-13 and 16 above, and further in view of Farrar ('931).

The combination process does not teach forming low dielectric constant layer to a thickness of about 6,000 Angstrom to 20,000 Angstroms.

Farrar is relied on for the teachings as discussed in the rejections of paragraph 4 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of low constant dielectric layers 102 and 104 to be performed in order to eliminate etch stop layers and reduce the number of fabrication steps.

5. Claims 14, 17-19, 23 and 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. ('880) in combination with Lopatin et al. ('954), Applicant's Admitted Prior Art (AAPA), Shacham-Diamand et al. and Liu et al. ('962).

Jiang et al. is relied on for the teachings as discussed in the rejections of paragraph 5 of the Office Action mailed on 3/31/03.

Jiang et al. does not list methylsilsesquiazane as one of the low-k dielectric materials nor teach patterning low dielectric constant layer to form openings in low-k dielectric layer by exposing to electron beam or ultra violet light and etching by tetra-methyl-ammonium hydroxide.

AAPA is relied on for the teachings discussed in the rejections of paragraph 5 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of the openings or trench 120 through low dielectric constant layer 104 and obtain further advantage of eliminating both photoresist and dry etching process steps.

The combination process does not disclose that the barrier layer is formed using tungsten nitride.

Lopatin et al. is relied on for the teachings discussed in the rejections of paragraph 5 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of barrier layer 106 in trench 120 of the combination process to be performed and obtain further advantage of providing excellent adhesion to the underlying low dielectric material (Lopatin et al., Col. 5, lines 37-39).

The combination process does not disclose removing portions of tungsten nitride layer above surface of low-dielectric constant layer by chemical-mechanical polishing prior to depositing copper layer.

Liu et al. is relied on for the teachings discussed in the rejections of paragraph 5 of the Office Action mailed on 3/31/03 as providing motivation to enable removal of portions of barrier layer 106 prior to copper layer deposition in the combination process and obtain further advantage of reducing amenability to dishing (Liu et al., Col. 4, lines 4-6).

The combination process does not teach forming copper layer by electroless deposition using contact displacement method at room temperature.

Shacham-Diamand et al. is relied on for the teachings discussed in the rejections of paragraph 5 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of copper layer 110 in trench 120 of the combination process to be performed and obtain further advantage of the low cost of the tools and materials and high throughput of the process (Shacham-Diamand et al., p. 48, 1st paragraph).

6. Claims 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. ('880) in combination with Lopatin et al. ('954), Applicant's Admitted Prior Art (AAPA), Shacham-Diamand et al. and Liu et al. ('962) as applied to claims 14, 17-19, 23 and 28-30 above, and further in view of Farrar ('931).

The combination process does not teach forming low dielectric constant layer to a thickness of about 6,000 Angstrom to 20,000 Angstroms by spin coating.

Farrar is relied on for the teachings discussed in the rejections of paragraph 6 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of low constant dielectric layers 102 and 104 of the combination process to be performed and obtain further advantage of eliminating etch stop layers and reduce the number of fabrication steps.

7. Claims 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang et al. ('880) in combination with Lopatin et al. ('954), Applicant's Admitted Prior Art (AAPA),

Shacham-Diamand et al. and Liu et al. ('962) as applied to claims 14, 17-20, 23 and 28-30 above, and further in view of Kaloyeros et al.

The combination process does not teach the step as recited in claim 24, lines 1-2.

The combination process does not teach the step as recited in claim 25, lines 1-2.

The combination process does not teach the step as recited in claim 26, lines 1-3.

The combination process does not teach the step as recited in claim 27, lines 1-3.

Kaloyeros et al. is relied on for the teachings as discussed in the rejections of paragraph 3 of the Office Action mailed on 3/31/03 as providing motivation to enable the formation of copper layer 110 of the combination process to be performed and obtain further advantage of copper film having uniform, continuous and low resistivity (Kaloyeros et al., p. 84, 1st paragraph).

Response to Arguments

8. Applicant argues that neither Jiang et al. nor Farrar teach removing portions of the tungsten nitride layer and subsequently providing a copper layer as recited in claim 1. However, the claims are not so limited.

9. Applicant argues that Lopatin et al. does not suggest removing portions of the tungsten nitride layer prior to providing a copper layer. However, Lopatin et al. is not relied upon as containing that teaching. Lopatin et al. is relied on for the teaching that the barrier layer is comprised of materials such as tungsten nitride. Furthermore, Liu et al. is relied for the

teachings of removing portions of tungsten nitride layer above surface of low-dielectric constant layer by chemical-mechanical polishing prior to depositing copper layer.

10. In regard to applicant's argument on page 11, 1st paragraph, of the amendment mailed on 6/24/03, AAPA is relied on for the teachings of low-k dielectric materials and the method of patterning the low-k dielectric layers.

11. Applicant argues that Liu et al. fail to disclose forming tungsten nitride layer by atomic-layer deposition using sequential surface reactions. However, Liu et al. is not relied upon as containing that teaching. Lopatin et al. is relied on for that teaching instead. Furthermore, Liu et al. discloses that barrier layer 170 is comprised of material such as tungsten nitride and tantalum in Col. 6, lines 31-36.

12. Applicant argues that Liu et al. neither disclose pattering low-dielectric constant nor forming opening through methysilsequiazane layer by etching with tetra-methyl-ammonium hydroxide solution. However, Liu et al. is not relied upon as containing those teachings. AAPA is relied on as containing those teachings instead.

13. Applicant argues that Liu et al. teaches using preferred materials such as PECVD oxide for the dielectric layers instead of low-k dielectric materials. However, although not taught as a preferred embodiment, Liu et al. teaches this embodiment nonetheless, and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or

nonpreferred embodiments. MPEP 2123. In re Susi, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." In re Gurley, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994). A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill the art, including nonpreferred embodiments. Merck & Co. v. Biocraft Laboratories, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989). Even a teaching away from a claimed invention does not render the invention patentable. See Celeritas Technologies Ltd. v. Rockwell International Corp., 150 F.3d 1354, 1361, 47 USPQ2d 1516, 1522-23 (Fed. Cir. 1998), where the court held that the prior art anticipated the claims even though it taught away from the claimed invention. "The fact that a modem with a single carrier data signal is shown to be less than optimal does not vitiate the fact that it is disclosed." To further clarify, a prior art opinion that a claimed invention is not preferred for a particular limited purpose, does not preclude utility of the invention for that or another purpose, or even preferability of the invention for another purpose.

Conclusion

14. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Suk-San Foong whose telephone number is 703-305-0383. The examiner can normally be reached on Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 (7724, 3431, 3432).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

SF
October 20, 2003

George Fourson
Primary Examiner
Art Unit 2823